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Annual Report
Fiscal Year 1980

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HE 20.3035:

A Letter From the Director

Joe R. Held, D.V.M., Director
Division of Research Services
National Institutes of Health

Those of us responsible for providing the essential services that support biomedical research face a continuing challenge in coping with the relative declines in available resources. Simply put, we must be constantly searching for ways to increase the efficiency and effectiveness of our services so the high quality of biomedical research at NIH will be maintained.

An illustration of this process can be found in the essay by Walter S. Friauf of the Division's Biomedical Engineering and Instrumentation Branch (BEIB) on page 9 of this report. He tells how a careful analysis of the requirements of an investigator in conducting an experiment may yield major savings in time and money in selecting the proper instrumentation.

The article examines the virtues of the instrument interconnection technique (the IEEE-488 bus) widely available in industry which in many applications is cheaper and requires much shorter software development time than a microprocessor. The technique has great flexibility and can use hardware readily obtainable in BEIB's scientific equipment rental pool at minimal cost. Assisting investigators in evaluating different instrumentation approaches and avoiding what could be costly mistakes is one of the BEIB staff's key functions in keeping the quality of supporting services high, yet efficient.

Indeed, a review of Fiscal Year 1980 activities shows the Division is exerting leadership to develop new and more cost-effective research support for the entire biomedical community. These efforts take a number of different forms:

- Primate supply programs for both intramural and extramural research are being coordinated—at considerable cost savings—by the Interagency Primate Steering Committee. NIH is the lead agency of the committee which is administered by the Division's Veterinary Resources Branch. The committee has issued a National Primate Plan and during the past year initiated a number of projects, including one with the World Health Organization, to assure a continuing adequate supply of various species through conservation measures and captive breeding programs. A new center was created to breed and rehabilitate chimpanzees—an endangered species no longer procurable in the wild—from stock presently in the United States.
- Methods are being improved for monitoring the genetic purity of strains of research animals. The Division has issued a strain catalogue for 150 rodents to help researchers expedite the procurement of animals. Many of these strains were bred by the Division to serve specific research needs.
- The care of research animals is being advanced by development of new methods of handling, including ways to minimize behavioral problems. Standardized laboratory animal diets formulated by Division nutritionists are being widely used throughout the scientific community—also helping assure better quality animals at lower costs.
- Biomedical engineering is finding more applications in collaboration with clinical reseachers. Recent studies by BEIB in support of the National Cancer Institute include a process for whole body hyperthermia treatment of cancer patients, the relationship between chemotherapy and impairment of the wound healing process, and measures of oxygen consumption by patients under varying clinical conditions.
- The Division has created a central microanalytic facility to develop new techniques and make them available to all NIH researchers - another forward step in providing services efficiently.

As these examples suggest, the work of the Division, which is organized primarily to serve intramural NIH research programs, is having a growing impact upon NIH extramural programs as well. Over time, we expect that closer coordination of services for the two programs, such as the procurement of laboratory animals from commercial breeders, can benefit from economies of scale and centralized quality control. This, in turn, can mean greater uniformity of animals for both programs, allowing research results to be compared more realistically.

Reorganization of Safety Programs

A plan has been developed by the Director of NIH to reorganize some of the service units so that support programs for intramural and extramural research can be coordinated within new organizational structures. During the year, the first step in the plan was executed with the creation of a new Office of Research Services under the Director, NIH. This office is now responsible for administrative services, facilities engineering services, and the NIH safety programs.

Under this reorganization, the Division's Environmental Safety and Radiation Safety Branches were transferred to the new office along with other safety programs on the campus to form a new Division of Safety. The management and operations of the Division of Research Services remain as before, reporting directly to the Director of NIH.

Financial Operations

The reorganization had an affect on the Division's budget for the year. Expenditures totaled approximately $25.5 million, a decrease of $2.5 million from FY 1979. The permanent staff declined to 451 from 555 full time positions. As the accompanying Table indicates, the budget decrease was almost entirely attributable to the transfer of the environmental health and radiation safety programs out of the Division. The only other decrease was in the Veterinary Resources Branch—about $151,000. This reflects a decline in our primate quarantine activities resulting from the fact that no rhesus monkeys were available for purchase and import.

Funding for the other three branches increased. Approximately $800,000 of BEIB's increase went into additional purchases of scientific equipment for the rental pool; most of the remaining amount was expended for equipment and renovation required by the new physical microanalysis facility. The Library's automation program was increased by nearly $600,000. A greater amount of contracting for graphics, the result of higher demand by NIH investigators for these services, accounted for the $740,000 increase in spending by the Medical Arts and Photography Branch.

Outlook for FY 1981

Demand for the Division's services and products has been increasing at the rate of 20 to 30 percent a year in many areas and especially in requests filled by the Library and the Medical Arts and Photography Branches. To meet an anticipated greater demand in FY 1981, we will continue to increase our efficiency at the same staff manpower level. This will be accomplished by installing more automated systems and the employment of overtime and outside contractors.

Automation will be applied in greater degree to control the circulation of journals by the Library, to increase the output of graphics, and maintain record-keeping on animals.

Contract breeding programs of primates will be expanded to offset the continuing shortfall of wild-caught monkeys. The primate program also will concentrate on breeding additional species, long-term holding, and research and development.

We will keep expanding the amount of hardware available in the BEIB scientific equipment rental pool. This has proven to be one of the Division's most popular programs. Investigators have discovered the rental pool is a top source of equipment —and usually the most cost-effective way of obtaining what they need in the shortest time.

In sum, the Division will continue to step up the efficiency of its operations as it prepares for another productive year in delivering products and services of the highest possible quality in support of all phases of research at NIH.

Division of Research Services
Annual Budget
(in thousands of dollars)

	FY-79	FY-80	Increase/ Decrease
Veterinary Resources	$10,197	$10,046	$ -151
Biomedical Engineering & Instrumentation	7,039	8,462	+ 1,423
Library	2,137	2,731	+ 594
Medical Arts & Photography	3,536	4,276	+ 740
Environmental Health & Safety	5,162		-5,162
Total	$28,071	$25,515	$-2,556

The Division of Research Services

The many specialized functions of the Division are designed to support all of the 18 Bureaus, Institutes, and Divisions (BIDs) which constitute the National Institutes of Health. The primary program emphasis, however, is directed at serving the 5,000 staff members of the intramural program, including more than 2,400 doctoral level scientists who conduct research in NIH laboratories.

Organizationally, the Division is structured to provide products and services in support of the sequential steps in every biomedical research project: planning, making available models and substrates, manipulating and measuring research materials, and recording and communicating research results.

- The Library Branch possesses or has access to virtually all published biomedical knowledge to assist the investigator in planning and designing his/her project.
- The Veterinary Resources Branch provides the animal models, organic materials, and proper facilities for their use.
- The Biomedical Engineering and Instrumentation Branch collaborates with the investigator in devising the means whereby research materials may be manipulated and results measured, often with highly sophisticated electronic equipment.
- Finally, the skills of the Medical Arts and Photography Branch are available to all investigators to enable them to record and communicate the results of their research to the scientific community.

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Biomedical Engineering and Instrumentation Branch

Murray Eden, Ph.D., Chief

During Fiscal Year 1980, the Biomedical Engineering and Instrumentation Branch continued to provide a wide variety of specialized engineering and physical science skills to the NIH research community. BEIB engineers collaborated in more than 200 projects to produce advanced instrumentation models, methods, and techniques dedicated to the acquisition of biomedical information previously not available to the research scientist.

The Branch's skills cover a great many disciplines. The staff includes 35 professional physical scientists and engineers as well as 75 technical support personnel: machinists, glassblowers, instrument makers, electronic and mechanical technicians. During the year, the Branch responded to over 3,500 requests from NIH scientists for the fabrication and modification of laboratory devices and made another 8,000 repairs or minor changes to scientific equipment.

The range of projects spans NIH research interests. Most entail design or refinement of instruments to measure, observe, or describe in *vitro* or in *vivo* biological systems in an analytic or quantitative way. The systems we have helped to study represent virtually every level of organization; biomedical, cellular, organ or tissue, and holistic.

In the fall of 1979, BEIB sponsored an NIH Consensus Development Conference on "The Use of Microprocessor-Based, 'Intelligent' Machines in Patient Care." The "microcomputers" can even be implanted biologically and are creating new medical technologies—including some that may ultimately allow machines to exercise a degree of autonomy over patient care. Their application raises both technological and sociological questions:

Would these devices truly be more reliable or cost-effective than manual methods? Would they lead to improved patient outcomes?

What ethical-legal issues can arise in their development, testing, and marketing?

What might be their long-term, adverse consequences? How could these ill-effects be avoided?

How might one verify that the devices perform those functions—and only those—which their designers intended?

The conference was organized to allow practitioners, researchers, and others to discuss these issues during a formative stage of the technology's development, so as to guide it along lines that would be responsive to society's needs. A series of working papers (NIH Pub. No. 79-1852) prepared for the conference may be obtained from BEIB. A book containing a number of the papers presented at the conference, as well as the working papers, is to be published in Fall 1980.

BEIB's professional staff functions under four sections and a program (in physical microanalysis) currently contained within the Office of the Chief. Here is a brief review of FY 1980 activities:

Applied Clinical Engineering Section—This multi-disciplinary group, physically located within the NIH Clinical Center, works directly with biomedical scientists in patient settings. During the year, a whole body hyperthermia project was completed. The system is intended to reduce the population of growing cancer cells by maintaining patients with cancer at elevated temperatures on the theory that dividing cancer cells are more sensitive to higher temperatures than normal tissue cells. At

these elevated temperatures the physiological system of man loses its ability to regulate body temperature. The engineering system must hold the heat supply fast at the edge of the temperature zone living tissues can tolerate. The treatment, employed over 500 times, has proved to be able to raise the whole body core temperature in humans to 41.8 °C and to maintain that temperature within one-tenth of a degree for periods as long as four hours.

Studies were completed on the strength of newly grown repair tissue, an issue that bears on the treatment of cancer. Cancer specialists have suspected that the chemotherapy provided to patients after they have undergone surgery for tumor removal has acted upon the growing cells of the repair tissue and impaired the wound healing process. Wound breaking strength measurements made on the surgically wounded skin of rats showed that the agent adriamycin causes the repair tissue to be significantly weaker, but that impairment of healing can be minimized by suspending the administration of the therapeutic agent for three or more days following surgery.

The section is currently investigating the measurement of oxygen consumption for three different clinical purposes. The Clinical Care unit requires a technique for measuring oxygen consumption in the oxygen enriched air of a ventilator. The Anesthesia Department has requested an oxygen consumption monitor for surgical procedures and workers in the National Cancer Institute have requested a system suitable for studying patients during chemotherapy. Each system has its own special constraints and will require a different technical solution.

Chemical Engineering Section—Recent work by the staff has increased the understanding of fluid flow relevant to arterial disease, and of the movement of chemicals in the body. Other developments include new instrumentation involving synthetic membranes and innovative application of synthetic polymers to very small catheters.

The appearance of atherosclerotic lesions (fatty deposits) at specific locations in the arterial tree has led many investigators to conclude that forces exerted by the blood may be a factor in the initiation and progression of the disease. The natural arterial network is extremely complex, however, and direct observations of blood flow in animals and man are difficult or impossible. Therefore, the section has constructed simplified plastic and glass models which permit many important measurements to be made. These measurements include wall shear stress and mass transfer by an electrochemical technique, velocity profiles by laser anemometry, and direct visualization of flow patterns by use of dye injection or tracer particles. They are expected to correlate with the incidence and location of the disease. It is already clear that rather subtle changes in geometry can have a profound effect on the flow patterns.

Principles of chemical reaction engineering have been applied to the problem of predicting the concentration-time course of foreign chemicals in the body. This has considerably improved the section's ability to generalize from one animal species to another and to design potentially improved and more rational drug therapies from fundamental principles. The section has examined the distribution of polychlorinated biphenyls in the tissues of several mammalian animal species and have developed a mathematical model to determine what aspects of the distribution can safely be predicted from one species to another, what aspects must be measured, and how these measurements could be used to predict the tissue burdens in humans exposed to environmental contaminants. Similar concepts were used to design anticancer drug protocols for the treatment of ovarian cancer or other malignancies confined to the peritoneal region.

Synthetic membrane technology is having a significant impact on the ability to design laboratory and clinical instruments which depend for their function on separation of two regions such as blood and a chemical sensor but which allow safe transfer of certain components essential to the measurement or process being conducted. For example, in collaboration with the Mechanical Engineering Section, one member of the section's staff developed a miniature probe to measure the acid concentration (or pH) of blood by a purely optical technique using a polymer-bound dye indicator. Patents on the pH probe are currently under discussion for licensing by the Government to private industry.

Electrical and Electronic Engineering Section—The section's principal initiative was devoted to developing a capability to implement "smart" instrument systems based on a new industry-wide standard interconnection system (see page 9). The section acquired a programmable calculator for use as a controller in such systems, and gained experience on several relatively simple applications. The section's resources for developing microprocessor-based instruments also were upgraded.

Much effort was applied to several major projects which are approaching completion, including a high resolution positron emission tomograph, an imaging system based on nuclear magnetic resonance, and a microprocessor-based instrument for use in the patient electrical safety program. Other microprocessor-oriented projects were completed for use in the areas of mass spectrometry and temperature measurement.

Mechanical Engineering Section—Most of the staff's efforts were spent on such long-term projects as a family of miniature catheters, a family of indwelling fiber optic miniaturized physiological sensors, microcalorimetric probes, radically improved techniques for neural mapping, and noninvasive blood pressure measurement. Mechanical design was performed for several large interdisciplinary projects, e.g., the NMP Imaging Magnet and the PET Scanner.

One of the novel types of miniature catheter advances through narrow tortuous blood vessels by turning itself inside out. The catheter is constructed by passing a miniature plastic tube (0.075 mm wall x 1 mm diameter) through a conventional catheter and bonding the two together at the distal end. After the conventional catheter is advanced into the vascular system as far as possible, the annular space between the two tubes is pressurized, forcing the inner miniature tube to move out of the outer tube, everting as it advances. The mode of operation avoids the buildup of friction forces between the blood vessel and the catheter which limits the travel of conventional and balloon catheters. It allows placement in the venous system, and eliminates vascular irritation arising from relative motion between the catheter and the wall. It is anticipated that the catheter will be used for highly localized selective delivery of fluids which will provide chemotherapy or solidify to block blood flow through vascular lesions.

Physical Microanalysis Group—The 200 keV microscope was moved to its permanent location, a 50 keV scanning electron microprobe was installed, and interfacing of a large laboratory computer to the electron microscope was begun. The computer will be used in an on-line mode connected to both the microscope and microprobe, permitting high speed transfer of images and spectra. This will allow the investigator to effect data reduction and manipulation of both spectra and images and then utilize the results to determine the next step of the analysis.

Scientific Equipment Services

During FY 80, the Technical Services of BEIB was reorganized into five sections and the name was changed to Scientific Equipment Services. SES responded to about 11,500 work requests at a cost of over $3,000,000 during the year. The new sections and their functions are as follows:

Mechanical Design and Scheduling Section—This section designs mechanical instruments and equipment to be fabricated for investigators in-house and on contract. Contracted work is checked by BEIB technicians to assure that it meets design specifications before it is forwarded to the researcher. Approximately 550 instruments and devices valued at $230,000 were fabricated on contract this year.

Mechanical Instrument and Fabrication Section—This section makes mechanical instruments and also develops improved fabrication techniques. The section is composed of the following: Glassblowing Unit, Precision Instrument Unit, and the Machine and Welding Unit.

Clinical Care Instrumentation Section—Located in the Clinical Center, this section provides maintenance, repair, testing, evaluation, modification, design, safety checking and fabrication of clinical care equipment. To increase efficiency of semi-annual preventative maintenance and safety checks of clinical care equipment, the section is switching from a manual to an automated system.

Research Instrumentation Section—This section provides maintenance, repair, testing, evaluation and modification of research equipment and the design and fabrication of electronic and electro-mechanical equipment. The section consists of a mechanical unit and two electronic units.

Materiel and Clerical Operations Section—This section maintains an inventory of commodities to support the operations of Scientific Equipment Services. It provides secretarial assistance, job processing, and recordkeeping systems.

Scientific Equipment Rental Program—This program is continuing to expand at a rapid rate to meet the needs of the NIH scientific community. Five hundred instruments valued at $1.5 million were added to the rental pool program this year. The program features same day delivery of available items. If a needed instrument is not in the inventory, the purchase of one that meets the investigator's specifications will be arranged.

Two Competing Approaches in Developing Custom Instrumentation

By Walter S. Friauf
Chief, Electrical and Electronic Engineering Section, BEIB

Rapid advances in the complexity and sophistication of scientific research have created severe problems for those called on to provide engineering and instrumentation support. It is true that advances in electronic technology also have been extremely rapid and far reaching, but bringing these advances to bear quickly and effectively is not easy. In fact, the task of simply evaluating the relative merits of all the instrumentation approaches that might be applied to a given experiment calls for encyclopedic expertise.

The technological resources of NIH are limited. A wrong choice can be costly not only in money, but also in the time and services of the technical professionals. For these reasons, it is useful to make a closer examination of the two major competitive developments in electronics of the 1970's.

The Microprocessor — High Software Costs

The first is the microprocessor. These are large-scale integrated circuits which serve as the central processing units of microcomputers. As such, they are key components, controlling the interpretations and execution of machine instructions. The system's perceived importance to intramural research is such that at least five different sections at NIH are applying this device. Nonetheless, its use in research has had a much different impact than in the electronics industry because of differing circumstances. Industry designs powerful instruments which are then mass-produced, allowing the R&D costs to be prorated. Each mass-produced instrument is relatively cheap because the hardware complexity is reduced by use of the microprocessor and software can be replicated at virtually no cost.

Unfortunately, neither of these latter benefits can be realized at NIH where most custom instruments are one-of-a-kind developments. Consequently, the high software development costs in programming time offset, at least in part, the other advantages of the microprocessor. Moreover, at NIH specifications for the appropriate instrumentation usually must undergo a considerable evolution as the research progresses. In industry when a marketable product has been developed there may be little further need for additional software. While

it might be thought that the flexibility through software of the microprocessor would be ideally suited to deal with changing needs, in reality the preparation of software for microprocessors is a slow process. Furthermore, major changes in the specifications in the course of the experiment can affect hardware inputs and outputs as well.

Flexibility of the "Bus" Approach

A second major electronic development of the 1970s, derived from the engineering community's concern for compatability of equipment, is the instrument interconnection technique - the IEEE 488 interface bus standard. The IEEE bus standard allows "smart" instrument systems to be developed by interfacing a controller and a group of standard commercial instruments and devices. For example, a system could include solenoid valves, stepping motors, and heaters to control an experiment; a pulse generator to provide stimuli; voltmeters, counters, and an electronic thermometer to make measurements; and a printer and X-Y plotter to present data and results.

All of these devices can function under program control provided by software for a programmable calculator or other controller, which would also provide data processing capability for the system. The controller would contain a microprocessor which provides control and computational power, but in this configuration neither the designer nor end user of the system would deal directly with the microprocessor.

Hardware development costs for such systems are virtually nil because all the components are interconnected by simply plugging in standard cables. Changes during development can be accomplished merely by unplugging and plugging in other instruments or more of them.

Of course, software is needed but the Biomedical Engineering and Instrumentation Branch's (BEIB) experience indicates that it can be developed much faster for a programmable calculator than for a microprocessor-based instrument. The reasons for this are not immediately obvious, but there seems to be a combination of several important factors. First, the bus interconnected system is inherently modular. This simplifies system checkout and eliminates a great deal of time spent determining whether the problems are with the hardware or the software. Second, much of the software needed for interfacing instruments is made available by the manufacturer with the instrument. Finally, the calculators usually used as controllers have been developed to satisfy a market of users who want to be able to write software simply. Accordingly, the manufacturers provide programming facilities which make software writing as accessible as possible. This has the additional benefit of making it easier for the user to modify and extend the software after the system has been delivered.

Saving Development Time

We have been in a position to compare the software development times for the two approaches on a number of systems of comparable complexity, and in one case, systems providing essentially identical functional capability. In all instances the lower development time for the bus system is very pronounced - usually approaching an order of magnitude. This is the factor of greatest significance at NIH.

Naturally, there are some disadvantages. The hardware component cost is much higher and the systems are larger. The first problem may be alleviated by utilizing components leased from the BEIB scientific equipment rental pool as much as possible. This also can greatly reduce delivery time delays. The same components can be reused over and over as instrumentation needs change.

If the size of the system becomes a problem it can subsequently be reduced to a custom microprocessor-based instrument. This approach may be easier than starting out with the microprocessor -especially when considerable experimentation is needed first to obtain the desired instrument specifications. We have just completed such a developmental sequence with excellent results. The most gratifying aspect was the simplification of software development for the microprocessor-based instrument even though the software developed for the bus system was not directly transferrable.

The bus approach will continue to evolve as more and more instruments - electronic balances, microscope stage drives, and the like - become available with the standard interface. New types of controllers also will appear. While the desk top calculators normally used as controllers so far have been very satisfactory, they were not developed primarily for that purpose. One radically different controller has appeared on the market so far, and the possibilities in this direction are unlimited. We can also look forward to a great increase in standardized modular software for such systems.

Thus the interface bus standard, though virtually unheard of in comparison to the microprocessor, may well be the electronic development of the '70s that is of primary significance in the '80s at facilities such as NIH with urgent, specialized, and constantly changing instrumentation requirements. We are building up our resources to exploit this technology.

Library Branch

Ruth C. Smith, Chief

This fiscal year saw the trend toward maximizing the accessibility of information enhanced and an increase in the effort to minimize the time loss by patrons in the use of the Library resources.

- The Library plans to upgrade its limited computer facilities. Authorization was received to purchase a turn-key mini computer system in order to automate the entire Library. Assisted by the staff of the Systems Design Section, Computer Systems Laboratory, DCRT, a request for proposal was prepared. It is now in the hands of the Negotiated Contracts Unit, Contracts Operations Section, Procurement Branch.
- To increase service to patrons the Reference and Bibliographic Services Section has made the following changes: (1) two reference staff members are now assigned to the upper level reference area; (2) telephones have been installed on the reference desks to take advantage of the proximity of the reference tools; and (3) the lower level reference desk has been replaced by a "help" telephone connected to the upper level desks.
- The Stacks and Copy Service monitors a self-service photocopying activity which totals about 1.5 million pages annually. To handle this enormous and ever-increasing volume and shorten the time it takes an individual to photocopy an article, one of the three copying machines was designated "express" for 15 pages or less and the other two machines were set aside for copying up to 30 pages. The 24-hour service was terminated.
- Processing of periodicals currently is controlled by the PHILSOM (Periodicals Held In Libraries of Schools of Medicine) automated serial records system operated by the Washington University School of Medicine, St. Louis. This is being converted from a batch system to an on-line system to increase its efficiency.
- The Translation Unit has added a translator and is working to improve its "flash" service to notify NIH investigators of newly available translations. During the year, the Unit completed the first translation into English of a part of the original 1882 monograph "Ueber die Multiplen Fibrome der Haut und Ihre Beziehung zu den Multiplen Neurome" by Frederick von Recklinghausen. This will comprise a chapter in a symposium on von Recklinghausen's disease being edited by Dr. John J. Mulvihill of the National Cancer Institute. The symposium will be published by Raven Press in the Fall of 1980.
- The Library also has centralized its purchasing and procurement for all units within the Administrative Office. This has speeded up the acquisition of materials needed to provide prompt service.

Outlook for FY 1981

Several of the modules for the new automated system are expected to be installed in the coming year. They will be those presently operational, such as circulation control and on-line catalogs. The Library will accept others, such as acquisitions and journals control, as they become available.

Lack of space in the journals collection continues to be a problem. Hard copies are being replaced with microfilm copies. As original volumes are removed, the microfilm cassettes will be located on the shelves in the correct alphabetical order, rather than in separate file cabinets. This will save library users from having to search for journals in more than one location.

Medical Arts and Photography Branch

Arthur F. Moore, Chief

Continuing the trend of prior years, demand for photographic, graphic arts, and other services increased by 26 percent in Fiscal Year 1980 - reflecting the expanding amount of new biomedical knowledge being generated by NIH investigators. Most of the Branch's work assists scientists in recording the results of their research and communicating it in published articles and papers.

The Branch's staff of 52 artists, photographers, and other specialists are highly skilled in meeting the needs of scientists for graphic presentations, still and motion picture photography, including photomacrography and photomicrography, and medical arts. Services also include the design and production of publications; the preparation of slides, vugraphs, and other projected visual aids; animation artwork; technical, general, and medical illustrations; exhibit design; statistical drafting; display charts; posters and medical models.

The philosophy of the Branch is to provide high quality professional services competitive in cost with commercially obtainable services. The staff monitors all graphic and photographic services procured by outside contract to assure quality standards are kept.

The heavier demand for finished artwork during the year was met by a corresponding increase in contract services and an acceleration in deliveries. Photographic services and graphic services are performed normally in five workdays. But 24-hour emergency service is available. Design work is turned out in 10 workdays; this time also may be reduced by the Branch staff in special cases.

Adequate leadtimes are the key to producing quality audiovisual materials at reasonable costs. Experience shows that many members of the NIH community fail to allow enough time for planning and production; errors often crop up in submitted raw data causing delays and higher costs. The Branch has extensive expertise in conversion of data into effective multimedia presentations. This counsel is readily available for all of the Branch's services and should be used earlier and with more frequency.

A graphic design manual prepared by the Branch is available to investigators to assist them in planning and producing desired visual communications. This publication is gaining wider acceptance and is helping to effect savings by establishing standards and reducing preliminary design problems. Following is a summary of FY 1980 activities:

Photography Section—Technological improvements were instituted in the areas of photomicrography, photomacrography, and photographic laboratory services. They were accomplished by increased technical training of personnel and by replacing old equipment with advanced photographic tools. The section employed outside vendor services from private photo firms in the Washington, D.C. area in addition to in-house facilities, in order to keep pace with the ever increasing calls for photography services.

Design Graphic Section—This unit is composed of highly trained, extremely dedicated personnel. The group is capable of filling requests for complex visual productions, which are continually mounting in numbers. The section had a productive year, augmenting output 20 percent with no increase in personnel and maintaining its usual high quality production. Requests for medical illustrations remained at a normal level throughout the year. Contracting was seldom used since few projects entailed short deadlines. Calls for medical models remained about the same as in FY 1979.

Motion Picture Section—The number of filming requests were about the same as 1979 with several more formal productions completed than in the previous year.

Outlook for FY 1981

Early in the new fiscal year, the graphics unit will acquire its own in-shop computer graphics capability; there will be a compatible contract backup. The photo section will install new equipment to widen the spectrum of magnification in fluorescent microscopy.

The Medical Arts and Photography Branch will continue to develop and implement a system to upgrade NIH visual communications. It will aim to improve, enlarge, and extend its services and seek additional ways to acquaint the NIH community with its skills. The importance of early counsel and planning for optimum service will be emphasized.

Veterinary Resources Branch

Robert A. Whitney, Jr., D.V.M., Chief

The program to assure future supplies of primates to meet human health needs was expanded during the year by the Interagency Primate Steering Committee, which is administered by the Veterinary Resources Branch. New projects included:

- A contract with the World Health Organization to start up an internationally-financed program to assist Asian and African nations in conserving and breeding native primate species.
- A wildlife management training program in cooperation with the Department of the Interior that is designed to improve the conservation of primates in Central and South America. The program is being operated by the University of Florida. A second conservation and breeding program for New World primates was launched with the Pan American Health Organization.
- Creation of a center for rehabilitating and breeding chimpanzees from among the present U.S. population of approximately 1,300 chimps held in zoos and by research laboratories. The center is being operated by the University of Texas. Chimpanzees are an endangered species that no longer can be taken in the wild.

The committee has issued a National Primate Plan to coordinate all conservation and breeding programs in the U.S. in order to offset the shortage of rhesus monkeys and other species needed for scientific purposes. About 35,000 primates are used annually by the U.S. biomedical community, mainly in Government-supported programs.

NIH, the principal agency funding biomedical research, is the lead agency on the committee. The membership of the committee is composed of representatives from the National Science Foundation; the Department of Defense; the Alcohol, Drug Abuse and Mental Health Administration; the Center for Disease Control; the Food and Drug Administration; the Office of International Health; the Veterans Administration; the Environmental Protection Agency; the State Department; the NIH Division of Research Resources; and the Office of Program Planning and Evaluation, NIH.

Comparative Reproductive Laboratory—In another major development, the VRB established a Comparative Reproductive Laboratory during the year that will develop a cryopreservation program for the storage of genetic material—embryos and spermatozoa—of unique animal models used in NIH research. This is to ensure that such valuable species as inbred rodents that comprise the international genetic resource will be available for future research programs.

The laboratory is conducting collaborative research with units of NIH and other Government agencies. The work centers on defining reproductive relationships and requirements of laboratory, domestic, and endangered species with particular emphasis on the development of animal research models for the study of human disease. These latter species include the VRB Animal Center's foxhound colony, monkeys, cats, goats, and inbred miniature pigs in addition to rodents. Laboratory personnel also furnish information and technical assistance to the biomedical community on fertility evaluation—employing such techniques as semen collection and evaluation, laproscopy, radioimmunoassays, and statistical analysis.

Staff Animal Behaviorist—In a further step to enhance the quality of animals supplied by VRB, a staff animal behaviorist was employed to identify environmental needs unique to each species. Enrichment programs are being developed to better match the environment to the animals' needs. Together with improved genetic definition and nutrition, this will reduce variabilities caused by stress, enabling the use of fewer animals.

VRB's programs are conducted through four sections. Here is a brief review of their FY 1980 activities:

Animal Center Section—This section produces, maintains, and develops large laboratory animals and provides related services and products for NIH investigators. The animals involved are mainly primates, farm animals, and carnivores (dogs and cats). Purebred foxhounds, swine, and monkeys are provided by breeding colonies.

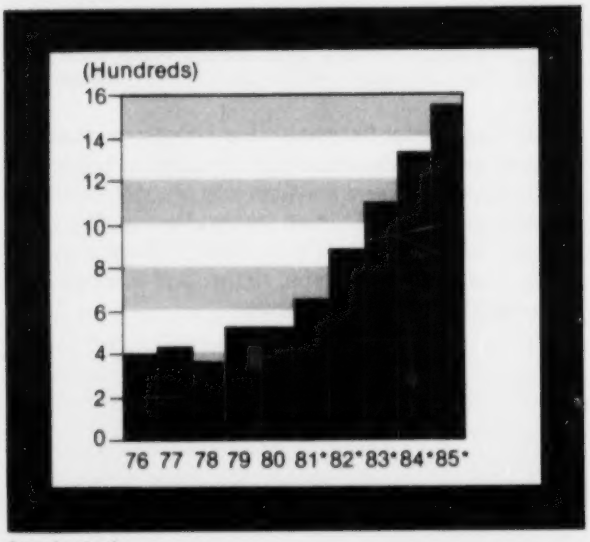
The Primate Quarantine Unit is procuring wild-caught cynomolgus monkeys for polio vaccine testing and NIH intramural research in place of rhesus monkeys. The rhesus supply has not been re-established since the last animals were received from Bangladesh in January 1979. Cynomolgus monkeys are arriving sporadically from Phillippine and Indonesian sources. All male rhesus monkeys from the VRB contract production colonies are being utilized for polio vaccine testing. This is expected to continue until 1982. All female rhesus monkeys produced are being held as replacement breeders for domestic colonies.

The two VRB contract production colonies of monkeys are being expanded to supply intramural and other Government agencies. The expansion is in accord with National Primate Plan objectives and will involve mostly cynomolgus monkeys and certain New World species. Current production levels are within expectations (see Figure 1).

The National Cancer Institute's herd of inbred miniature swine will continue to be maintained by the Ungulate Unit at approximately 200 head in order to provide sufficient progeny for histocompatibility and transplantation studies. During the past year, surplus NCI animals were sent to several laboratories to be used as breeding stock.

Automated plasmapheresis is being used to collect blood from livestock. The plasma can then be clotted to yield serum. This procedure provides an efficient method of collecting large volumes of plasma from a single animal. It also can selectively collect different blood components. Since its inception the demand for this service has continued to increase. The total number of livestock held has increased significantly over the past several years along with the number of livestock bleeding procedures.

Figure 1
Rhesus and Cynomolgus Monkey Production



*projected

The foxhound breeding colony is in the process of being moved to new facilities and increased puppy production is expected. For the third straight year, over 1,000 foxhound puppies were born. About 950 dogs were issued this year. The number of cats procured, quarantined, and issued per year is approaching 900 and is expected to remain at that level.

Comparative Pathology Section—This section is responsible for the health status of the laboratory animals produced, quarantined, or utilized in biomedical research at NIH. It also assures the genetic quality of NIH animals, which are shipped worldwide as a function of the World Health Organization-sponsored Genetic Resource.

The number of autopsies performed by the pathology service this fiscal year is 4,575, an approximately 110 percent increase from last year. This increase was caused by an outbreak of mousepox that was first diagnosed on November 28, 1979. The outbreak involved three NCI animal rooms on the fourth floor of Building 10 as well as a number of rooms in NCI-contracted holding space off campus. Also, a large amount of work was generated by the occurrence of false positive serologic tests for mousepox in another NCI contracted holding space. As a result of the outbreak, the number of samples processed for endo and ectoparasite monitoring, contracted virus monitoring, and hematology was 22,703 - a 327 percent increase over last year (see Figure 2).

Small Animal Section—Approximately 324,600 rodents and rabbits produced within VRB were issued for intramural research - a slight decrease from last year. This represents a continuing trend resulting from contracting production activities.

There was a slight decline in utilization of VRB-produced mice and rats. On the other hand, total issues of guinea pigs, hamsters, and contractor-produced rabbits increased slightly. Total purchases of rodents and rabbits from contractors rose from 648,000 to 683,000 (Figure 3).

There was no evidence of any compromise of genetic quality in any of the breeding goups during the year. Requests for new introductions are increasing; currently, there is a backlog of approximately 50 stocks and strains. New introductions during the year included the nude rat (*rnu*), and the RCS/N-*rdy-c*, RCS/N-*rdy-p*, and the RCS/N- + -*p* congenic rat strains. One inbred mouse strain (C3H/HeJ) and two mutant strains (dwarf and viable yellow) were introduced. One rat strain (RLA/N) was lost due to reproductive failure.

The introduction of the nude mouse gene into a number of inbred backgrounds is nearly complete. The demand for various nude mice, including the double deficient T and B cell mouse (NIH II-nu), continues to exceed available supply. This model has proven to be valuable in cancer, parasitic, and infectious disease studies. Development of an outbred rat (N:NIH) for use in general population studies such as alcchol abuse, etc., is nearly complete.

The nutrition program has been occupied with the concerns of the biomedical research community regarding the potential for chemical contaminants in laboratory animal diets. A limited amount of data procured to date indicates contaminant concentrations in NIH feed are typically below concentrations shown to adversely affect diet quality. Approximately 50 nitrosamine assays have been completed on samples of various NIH animal feeds. A new rodent diet manufactured without ingredients of animal origin to minimize contaminant concentrations is being evaluated.

Requests for assistance on problems related to animal nutrition were received from Peru, Columbia, Argentina, Mexico, the United Kingdom, Germany, and the Phillippines. The Section assisted development of adequate diets for recently established primate breeding colonies in South America. The Environmental Protection Agency and the National Toxicology Program also requested aid in establishing nutritional test standards. Investigators at NIH appear to be quite sensitive to the effects nutrition may have on experimental results. Hence, numerous requests are made for nutritional information or modifications in diet formulations to accommodate specific program requirements.

Veterinary Medicine and Surgery Section—Renovations in the central animal surgical area neared completion and the facility has been well equipped. This facility could be added to the list of potential auxiliary infirmaries in the event of a national disaster where emergency medical services are needed.

Figure 2
Clinical Pathology Samples

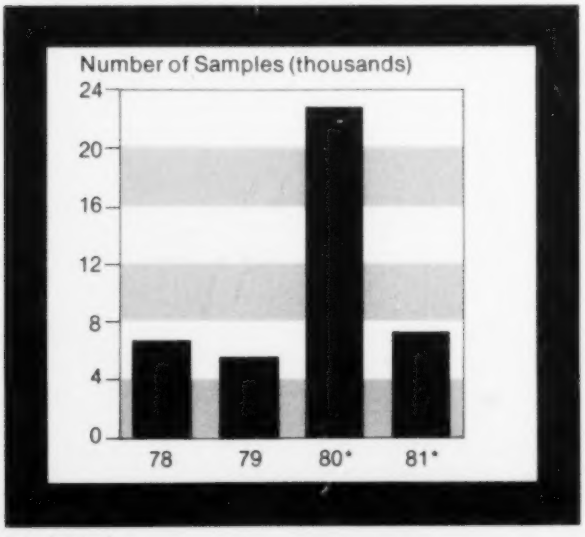


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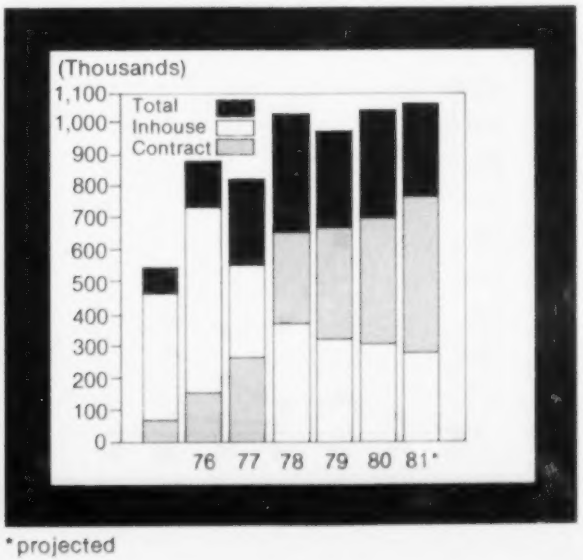
Figure 3
Total Animals Issued



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The minipig continues to grow in popularity as the animal model of choice for many investigations. Studies with cat leukemia necessitated housing cats in isolators. There is a trend toward increased use of small ruminants such as sheep and goats (Figure 4).

The nonhuman primate holding facility reached its capacity of 1,200 animals. Additional space was acquired through interagency agreements with the Department of Defense and the use of the Primate Quarantine Unit, NIH Animal Center, on a temporary basis. The primate recycle program continues to be viable. Issues were at an all-time high due, primarily, to unavailability of imported rhesus monkeys. Breeding of timed pregnant primates conducted in-house and on contract provided approximately 150 neonates. Needs were less than projected due to the shift in NIH intramural research emphasis.

Outlook for FY 1981

The Comparative Reproduction Laboratory program will be expanded. Artificial insemination techniques using both fresh and frozen spermatozoa will be tested in the foxhound breeding colony. The radioimmunoassay program, currently designed to analyze serum for steroid hormones, will be extended to protein hormones - including luteinizing hormone, growth hormone, and prolactin.

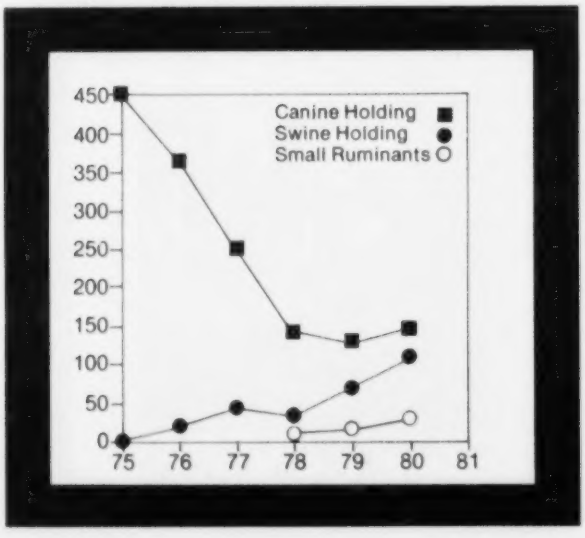
The Animal Center will add facilities to accommodate more livestock and dogs. Additional dog pastures also are to be constructed. A data processing system is being developed for the Carnivore Unit. It will be expanded and incorporated into other Animal Center activities.

Future primate supply activities for NIH and other agencies will rely upon expansion of contract breeding operations. The program will become more involved with breeding exotic species of primates, long-term holding, research, and development.

The first phase of a data processing program for the Small Animal Section is scheduled to be implemented during the next fiscal year. Development of the computer program and purchase of the initial hardware is planned for the fourth quarter of FY 1980. The Strain 2 and Strain 13 guinea pig production colonies will be contracted to commercial breeders.

Figure 4

Comparative Medicine Unit
Average Monthly Holding



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